Message

From: Kesler, Karen [Kesler.Karen@epa.gov]
Sent: 2/24/2021 8:07:40 PM
To: Fleisig, Erica [Fleisig.Erica@epa.gov]
Subject: FW: Thoughts on BAF approach for brainstorm
Attachments: BAF Approach 022221.xlsx

FYI, and one more.

From: Beaman, Joe <Beaman.Joe@epa.gov>
Sent: Wednesday, February 24, 2021 6:40 AM
To: Kesler, Karen <Kesler.Karen@epa.gov>
Subject: Thoughts on BAF approach for brainstorm

Good afternoon Karen,

To help us think through our recommendations for ND, I put together an exploratory analysis using the Minnesota River dataset.

I based the SSC for water on the EPA 2016 whole body criterion element.

Here is the approach, briefly:

1. Convert all tissue [Se] to whole body equivalents. Used species-specific EO/WB and M/WB CFs from EPA 2016 to convert egg-ovary and muscle to whole body
2. Derive mathematical "composites", by taking the mean for each species, treating each collection date as an individual "composite" for the purposes of BAF calculations
3. For each species derive BAFs for each distinct water [Se] by dividing the mean whole body [Se] by the water column [Se]. This yielded between 1, 2, or 5 (bluegill) BAFs for each species depending on the number of collection dates.
4. For each species, take the mean and 75th centile BAF (for species with one BAF, they are the same). This provides you a distribution of 12 species-specific BAFs using the mean and 75th centile BAF.
5. Take the 90th centile of both the mean and 75th centile BAF distributions
6. Divide the whole body criterion element by the 90th centile of the mean BAF distribution. This provides a water column SSC that protects most of the species in the river based on the "average" BAF-based bioaccumulation dynamics.
7. Divide the whole body criterion element by the 90th centile of the "75th centile" BAF distribution. This provides a water column SSC that protects most of the species in the river based on the "75th centile" BAF-based bioaccumulation dynamics.
8. I performed the same analysis for the bluegill data to look at a comparison between a water column value protective of a sensitive species (bluegill) vs a water column value that is protective of the entire fish community for the river. This approach makes no assumptions about selenium sensitivity.

	BAF Year							Mean	75th centile
Species	2012	2015	2015	2016	2016	2017	2017	BAF	BAF
Bluegill	2.86	0.45			1.06	0.43	0.77	1.114	1.96
Gr Sunfish					0.96			0.96	0.96
OS Sunfish				1.21	1.24			1.22	1.23
Black Crappie		0.92						0.92	0.92
Smallmouth Bass		1.03						1.03	1.03

Walleye		0.75	0.76					0.75	0.75
White Bass		2.04	2.18					2.11	2.15
FW Drum		1.4	2.85					2.125	2.49
Common Carp	1.79							1.79	1.79
Emerald Shiner	3.14							3.14	3.14
S. Redhorse		1.05						1.05	1.05
Fl Catfish		0.51						0.51	0.51
							90th centile BAF	2.1235	2.45325
							SSC	4.00	3.46

	BAF Year							Mean	75th centile
Species	2012	2015	2015	2016	2016	2017	2017	BAF	BAF
Bluegill - Main	2.86	0.45			1.06	0.43	0.77	1.114	1.96
Bluegill - Oxbow		0.87				0.49	1.34	0.9	1.105
							90th centile BAF	1.0926	1.8745
							SSC	7.78	4.53

Some thoughts about this analysis as it relates to ND logistical assumptions and constraints

1. Given the results above, an approach that protects the fish community, rather than a particular "sensitive" fish species seems to insure the protection of sensitive fish as well as fish of unknown sensitivity.
2. Although this analysis is for 1 waterbody, it lends itself to being expanded to a categorical approach for wadeable streams, rivers, and impounded waters, including lakes for multiple waterbodies in a category classified by a unifying metric (e.g., wadeable streams in same ecoregion; statewide criteria for lakes)
3. This approach (looking at the fish community common to a category of waterbodies) can leverage the ND logistics with regard to sample number, whereas it may be difficult to capture the variability of individual waterbodies examining an individual species given 5 samples.
4. If a common target species or two (availability at 50% or more sites) can be established, than it may not be necessary to assess variability at any one site, as long as sufficient samples are taken across sites to provide the statistical power to provide an approach to insure a given species is protected across sites and perhaps group sites in a more refined manner if that becomes important.
   A simple approach for addressing variability between sites might use summary statistics (mean and SD) for establishing a priori decision rules for using i). the mean BAF across sites or ii). a more conservative BAF (e.g.) established for a species across sites
   a. Species A, Dataset A – all BAFs are within 1 standard deviation of the mean BAF for species A – use the mean BAF
   b. Species A, Dataset B – 1 or more BAFs are above the mean BAF + 1 SD for species A - use the 75th centile BAF
      Example: Bluegill (mainstem): mean BAF = 1.11; SD = 1.01, so mean + 1 SD = 2.12. Since 1 of the sampling events (April, 2012, 2.86) resulted in a BAF that exceeded the threshold (mean + 1 SD), then the 75th (or 80th) centile of the species-specific BAF distribution as appropriate, is applied.
   c. Species A, Dataset C – 1 or more BAFs are above the mean BAF + 2 SD for species A – use the 95th centile BAF, or if only 1 waterbody contains more extreme values, it may be an appropriate candidate for a site specific criteria

d. The ability to collect 10-20 composites of a single fish species across a category of waterbodies (e.g. wadeable streams) may provide a more robust estimate of variation than a maximum of 5 samples at any one site.

5. The set aside samples (15 – for revisiting 3 waterbodies) could be used for an individual species in a waterbody to assess intra-site variability t

I also did a little research on ND waterbodies and fish so we can provide more effective recommendations to ND:

First we should be clear that assessing 20 lotic waterbodies in Ecoregion 46 will likely not be sufficient to characterize lotic waterbodies in ND.

Waterbodies: https://geology.com/lakes-rivers-water/north-dakota.shtml
There are 3 major river basins in ND (Missouri, Red, and Souris Rivers). There are approximately 40 major tributaries to these rivers. These are large rivers, many larger than wadeable streams judging from the pictures. My understanding (based on our discussion with Pete Wax and his coworkers) was that ND is planning on sampling wadeable? streams in Ecoregion 46. We should talk with ND to understand what their perspective is on what they think these 20 waterbodies represent.

I know that they are planning to do additional samples for lakes/impounded waters, but we need to get clarity on the lotic coverage so that we can provide feedback prior to their development of the sampling plan.

Selenium: https://mrdata.usgs.gov/geochem/doc/averages/se/north-central.html
Selenium is generally elevated in all ecoregions in the state. A few of the counties in Ecoregion 46 are a little lower than the surrounding counties.

Fish: https://gf.nd.gov/wildlife/id/fish/state-list
There are a boatload of fish species here, some are more common to lakes and impounded waters (particularly nonnative species due to stocking).
I think we need to better understand